

MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

TESTING AND DEVELOPMENT OF A LOW COST, DIGITAL SIGNAL PROCESSOR-(DSP) BASED TORPEDO COUNTERMEASURE (U)

Mark T. Evans-Lieutenant, United States Navy

B.S., United States Naval Academy, 1992

Master of Science in Engineering Acoustics-September 1998

and

Robert J. Jezek Jr.-Lieutenant, United States Navy

B.S., United States Naval Academy, 1992

Master of Science in Engineering Acoustics-September 1998

Advisors: Donald P. Brutzman, Undersea Warfare Academic Group

Thomas G. Muir, Chair of Mine Warfare

The wide spread proliferation of modern submarines and torpedoes has significantly increased the threat to U.S. Naval Forces. Current U.S. torpedo countermeasures are not as effective against the latest generation of torpedoes. A new torpedo countermeasure is required to provide an acceptable defense against these new weapons.

The cost of any system is an important characteristic in today's restrictive fiscal policy. The use of Commercial-off-the-shelf (COTS) technology can significantly reduce development and procurement costs of any military program.

This thesis details the acoustic testing, troubleshooting, and development of a new type torpedo countermeasure. This torpedo countermeasure is based on a Digital Signal Processor that allows a computer microprocessor to analyze a torpedo's sonar signal and generate an appropriate response signal as dictated by its programming. This gives flexibility that is a significant improvement over today's dedicated hardware systems and enables the device to outperform current countermeasures. Extensive use of COTS technology has minimized the cost of a prototype device. Computer simulation has played a large role in troubleshooting countermeasure software. Laboratory acoustic testing of the prototype hardware and software is described in detail, along with the resulting problems, proposed solutions and additional developmental steps.

DoD KEY TECHNOLOGY AREAS: Computing and Software, Conventional Weapons

KEYWORDS: Torpedo Countermeasures, Digital Signal Processing, Acoustic Modem, Acoustic Telemetry, Acoustic Decoy, Signal Analysis

MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

HIGH FREQUENCY COMPONENTS IN BOTTLENOSE DOLPHIN ECHOLOCATION SIGNALS

Ronald W. Toland, Jr.-Lieutenant, United States Navy
B.S., United States Naval Academy, 1992

Master of Science in Engineering Acoustics-September 1998

Advisors: Thomas G. Muir, Chair of Mine Warfare
Steven R. Baker, Department of Physics

The research described in this thesis is a continuation of work started by the Applied Research Laboratories of the University of Texas at Austin into the analysis of biosonar signals. Experiments conducted in 1997 on two species of small toothed whales found these species to emit significant high frequency signal components, extending to as high as 400 to 500 kHz.

To assess the importance of these high frequencies in dolphin echolocation and target identification, experiments were performed in which an acoustic filter, used to suppress the high frequencies, was placed between a dolphin and a target. Insertion Loss and Reflection Loss measurements performed on 1" thick and 2" thick Sound Absorbing Filters (SOAB) demonstrated their effectiveness at absorbing high frequencies above 150 kHz, with little reflectivity.

The results from one echolocation experiment, with one dolphin, showed the animal's ability to classify targets was essentially unaffected by the insertion of the filters. Analysis of the dolphin's echolocation signals showed the animal definitely compensating for the filters, by increasing its sound energy output, especially at frequencies above 100 kHz. It is anticipated that this initial experiment will lead to future research in explaining the existence of these high frequency echolocation components.

DoD KEY TECHNOLOGY AREA: Other (Biosonar and Mine Detection)

KEYWORDS: Bottlenose Dolphins, Marine Mammal Systems, Echolocation Signals, Biosonar, Mine Detection